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G2J
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A61B

(54) Ophthalmoscope free from corneal reflection

(57) An ophthalmoscope comprises a light source 1, a condenser lens 3, a diaphragm 4 and a mirror 5 illuminating the eyeground T_3 of a subject T with light from the light source. An observation optical system includes a lens 6 for observing the eyeground T_3 by reflected light. To reduce or eliminate reflected light from the cornea T_2 from entering the eye D of the examiner an analyzer 8 by which the angle of the polarizing axis is capable of being changed on the optical axis of observation is inserted in the reflected light path. A polarizer may also be inserted in the path of the illuminating light.

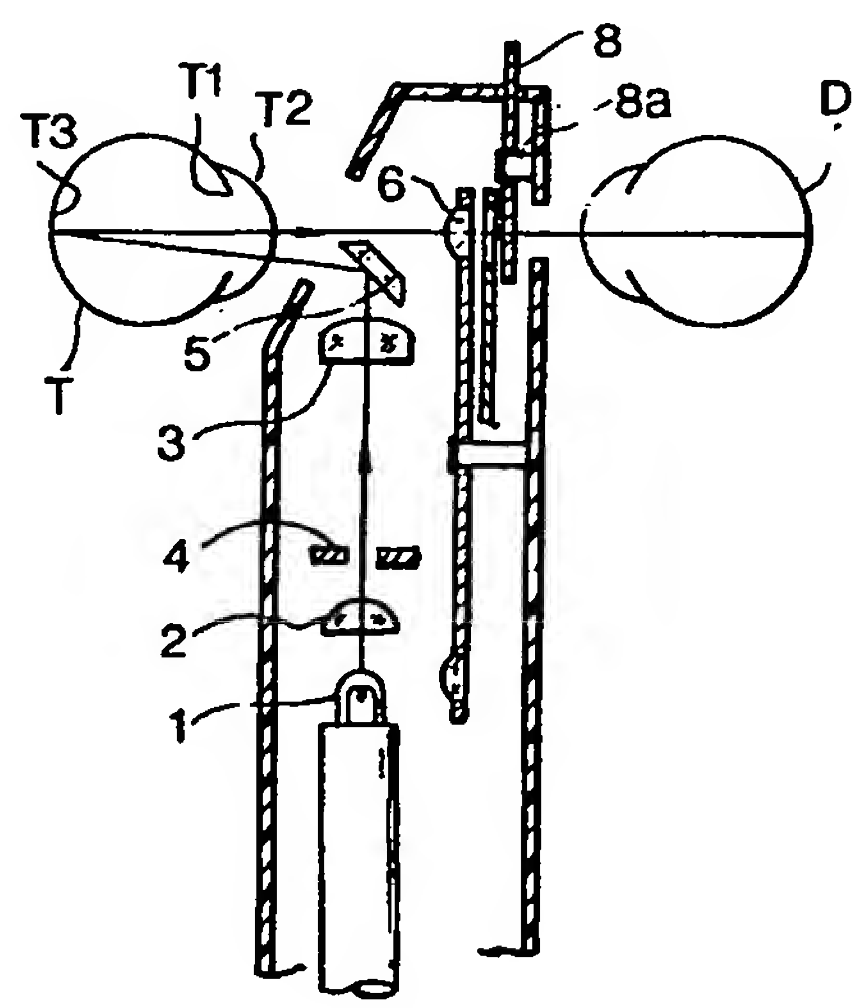

FIG. 3

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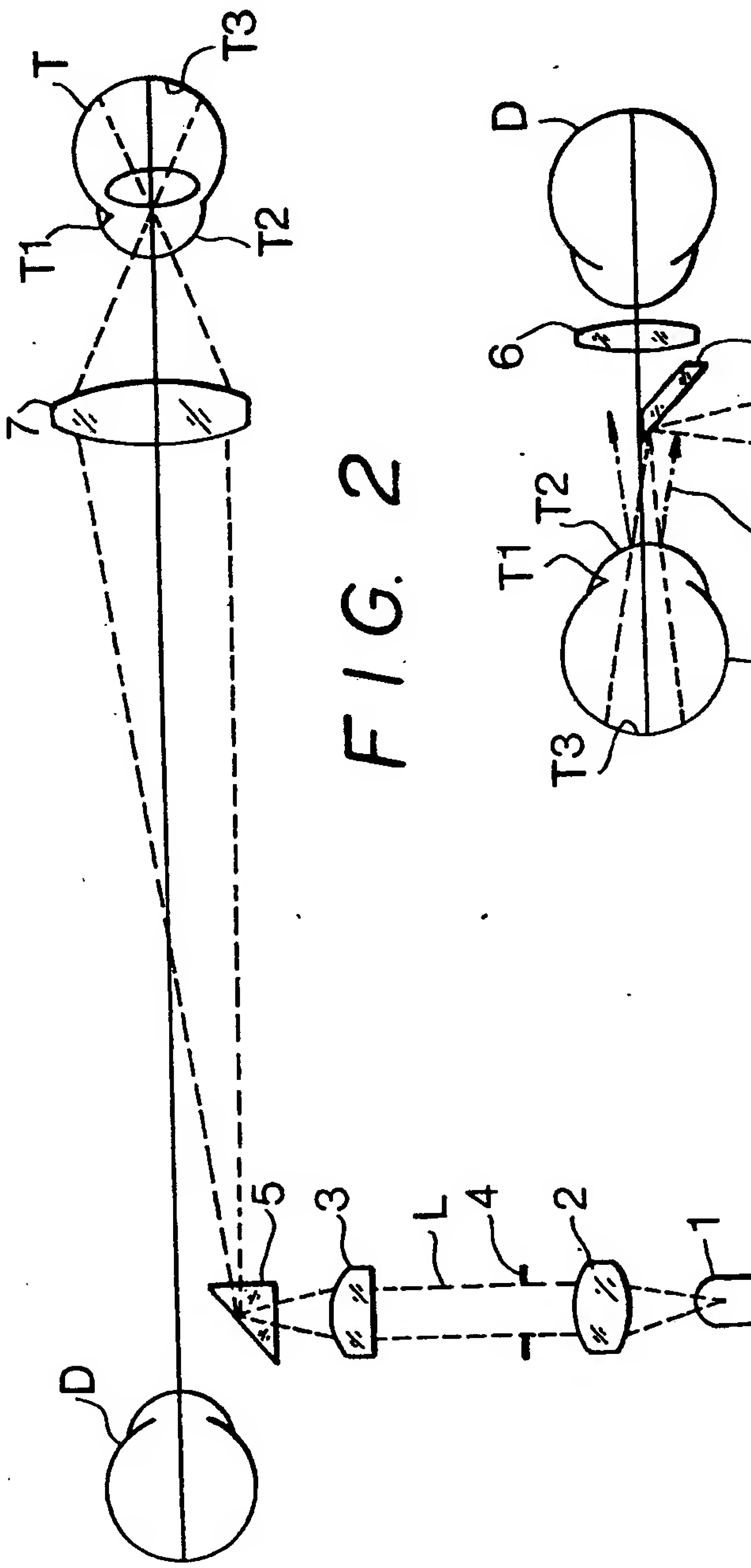


FIG. 2

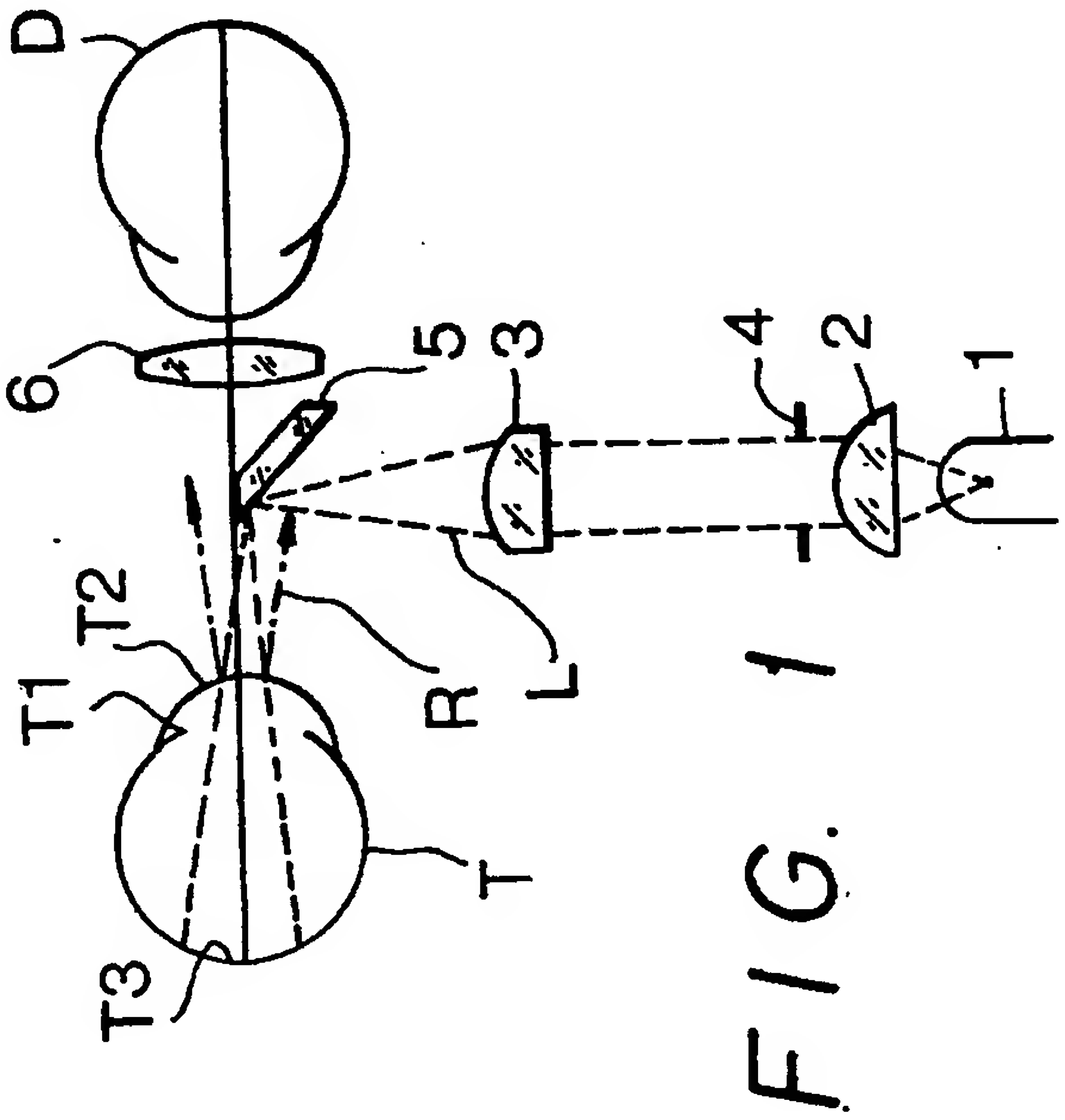


FIG. 1

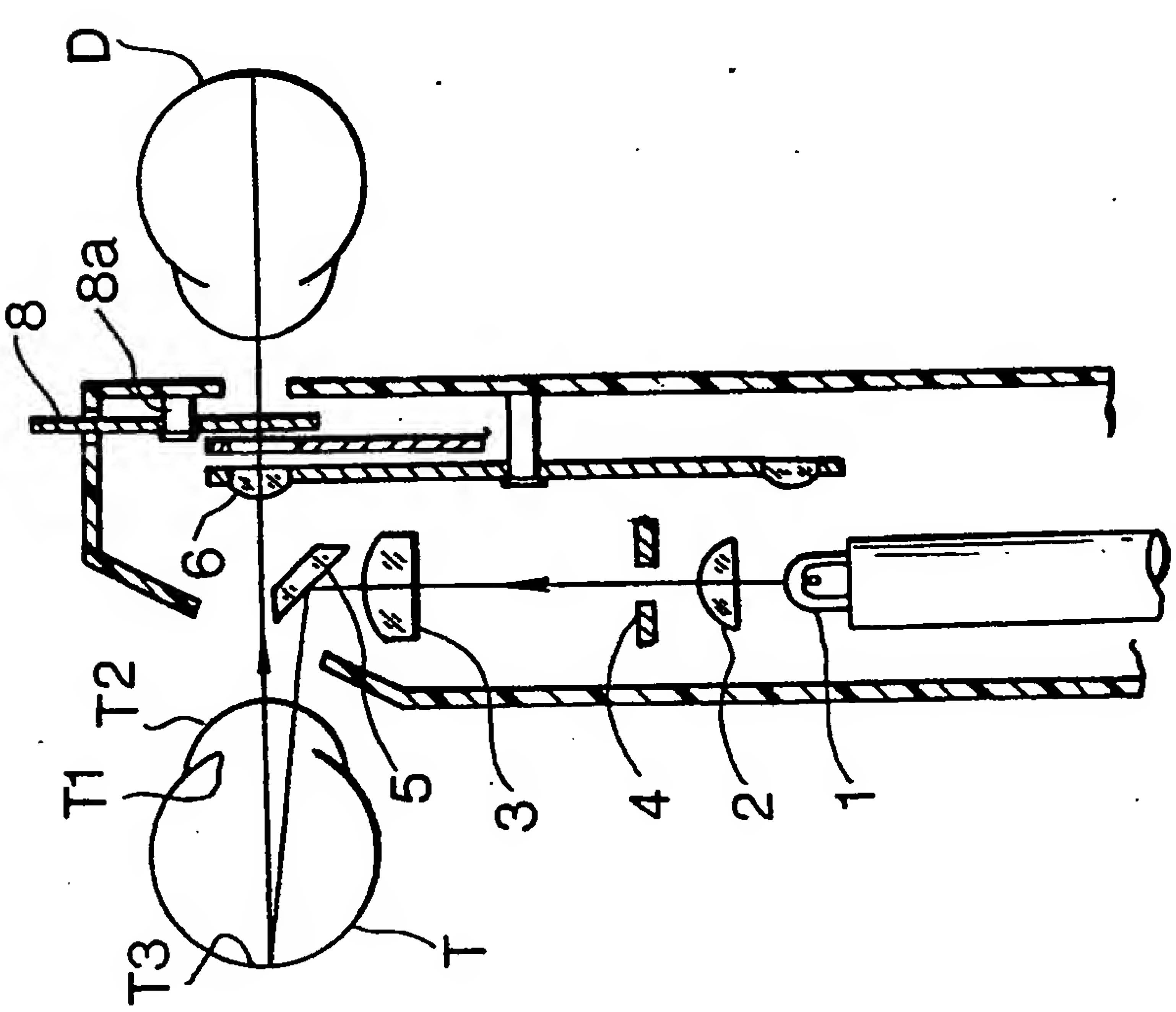


FIG. 3

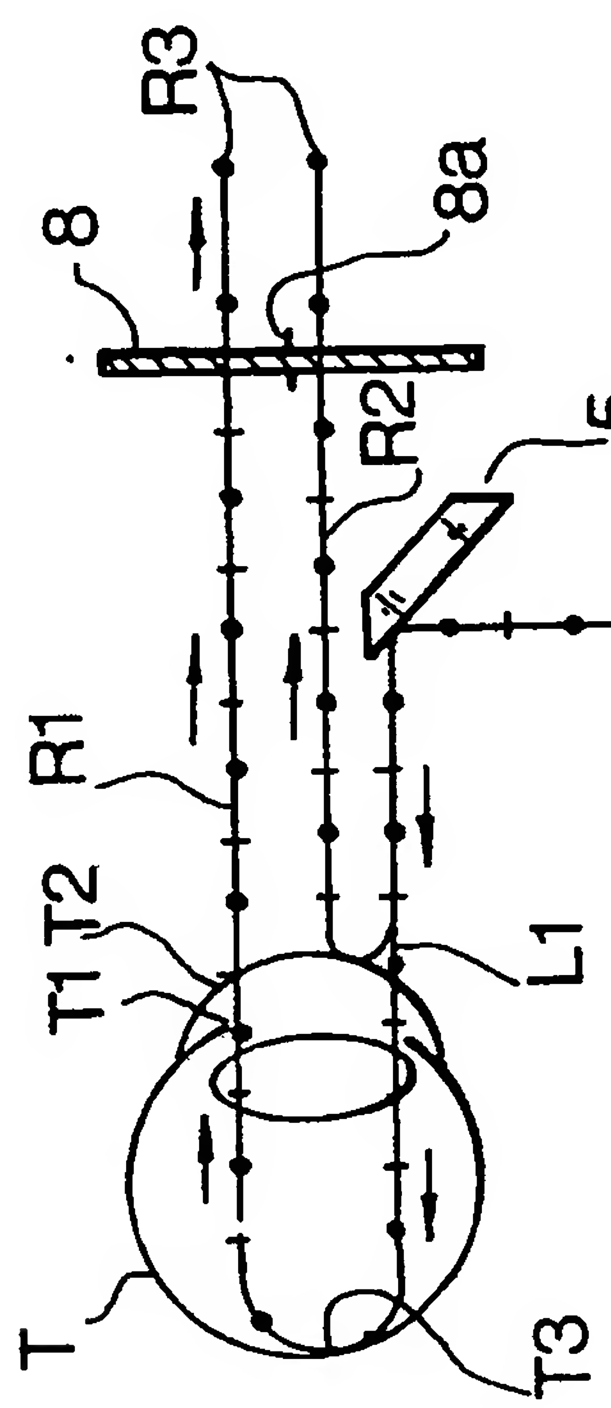
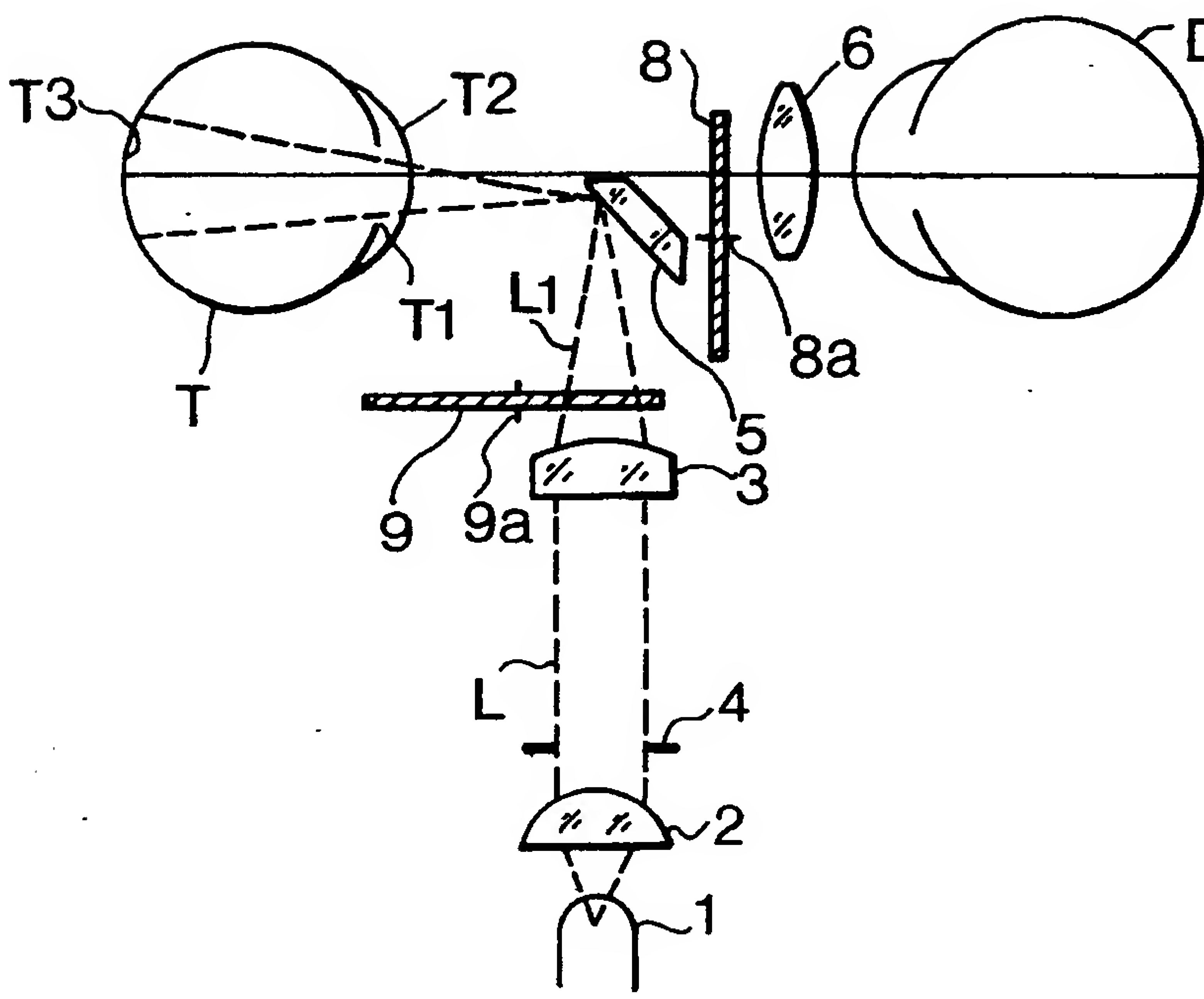


FIG. 4



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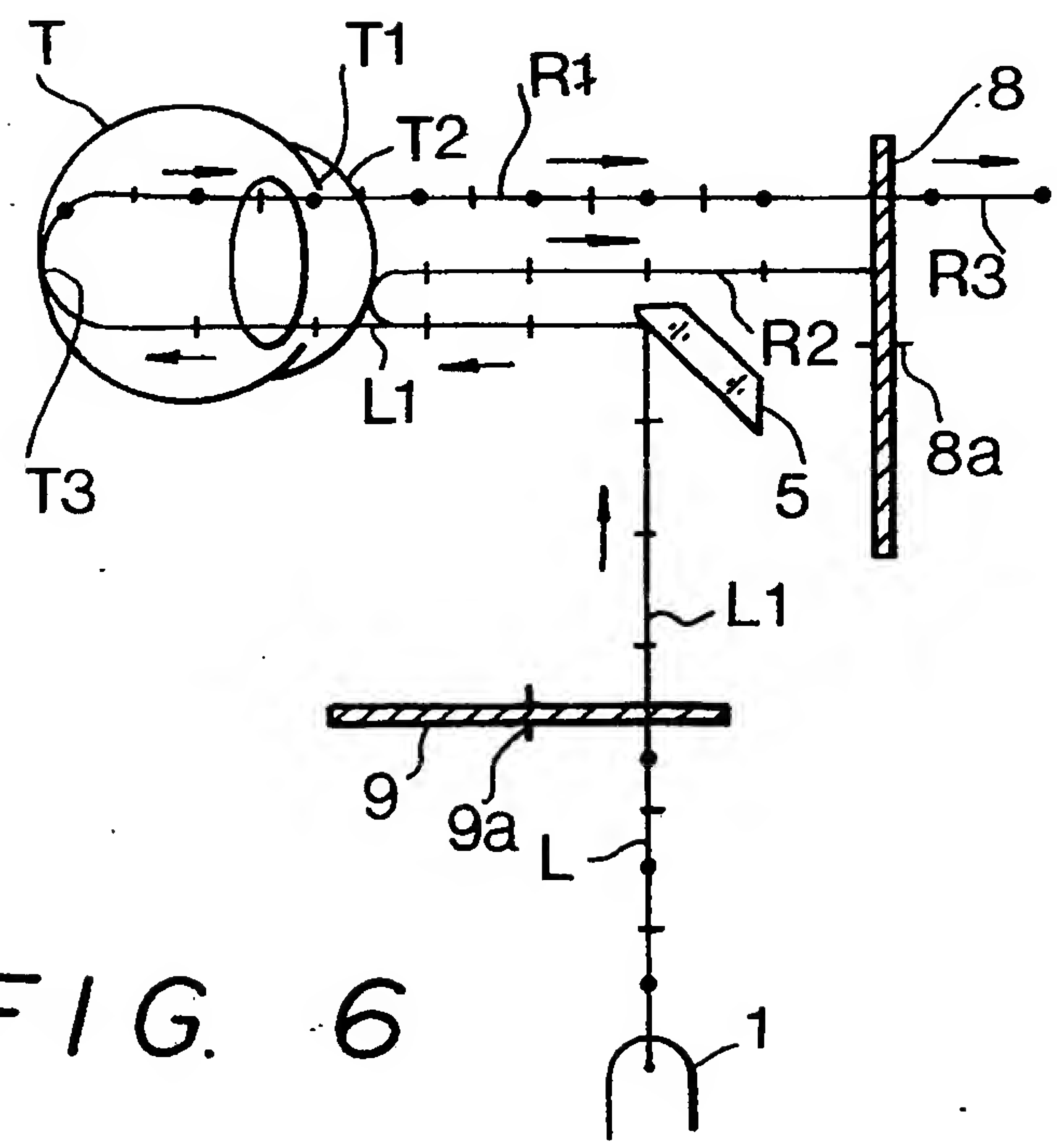

F I G. 6

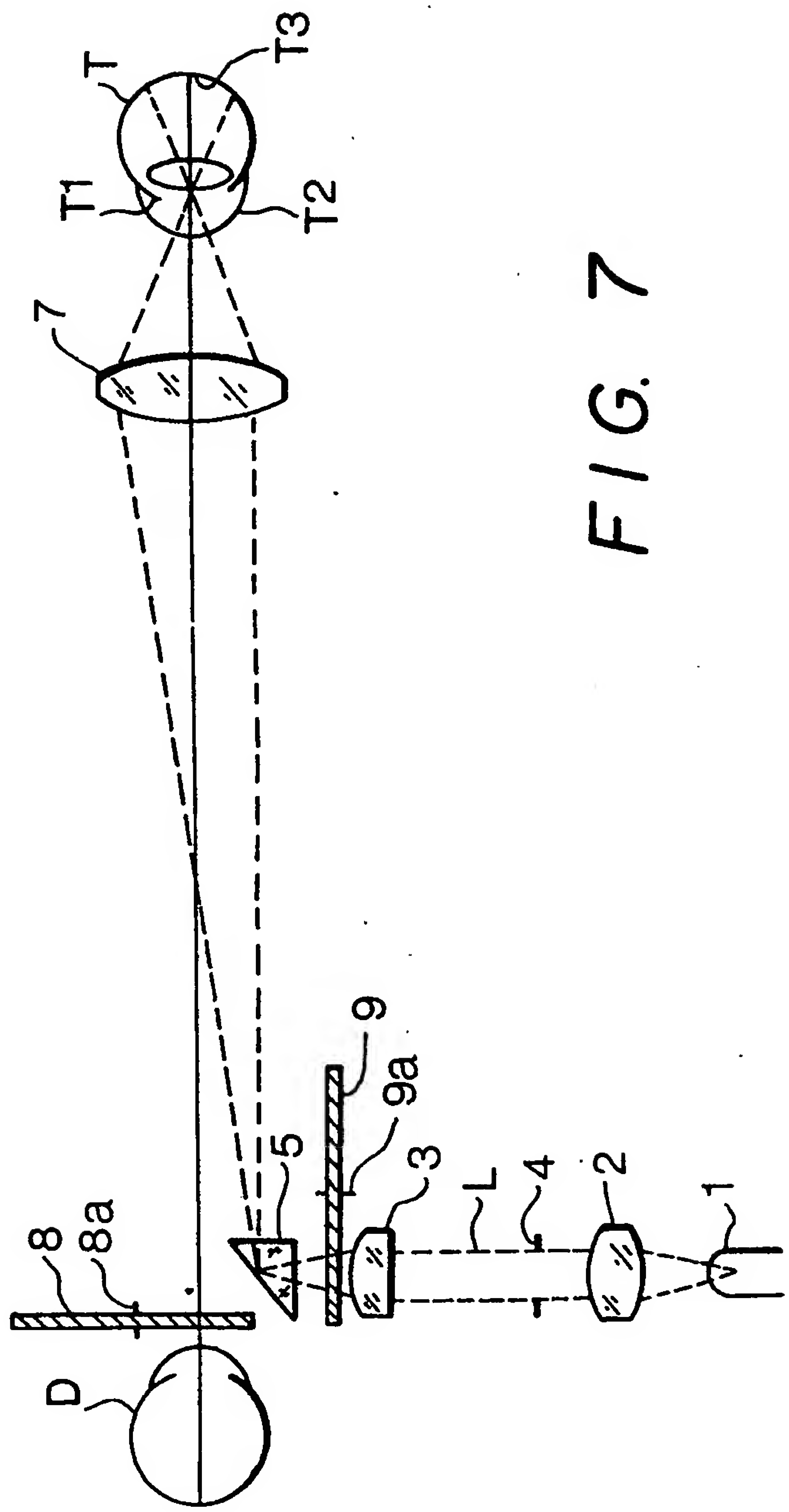

FIG. 7

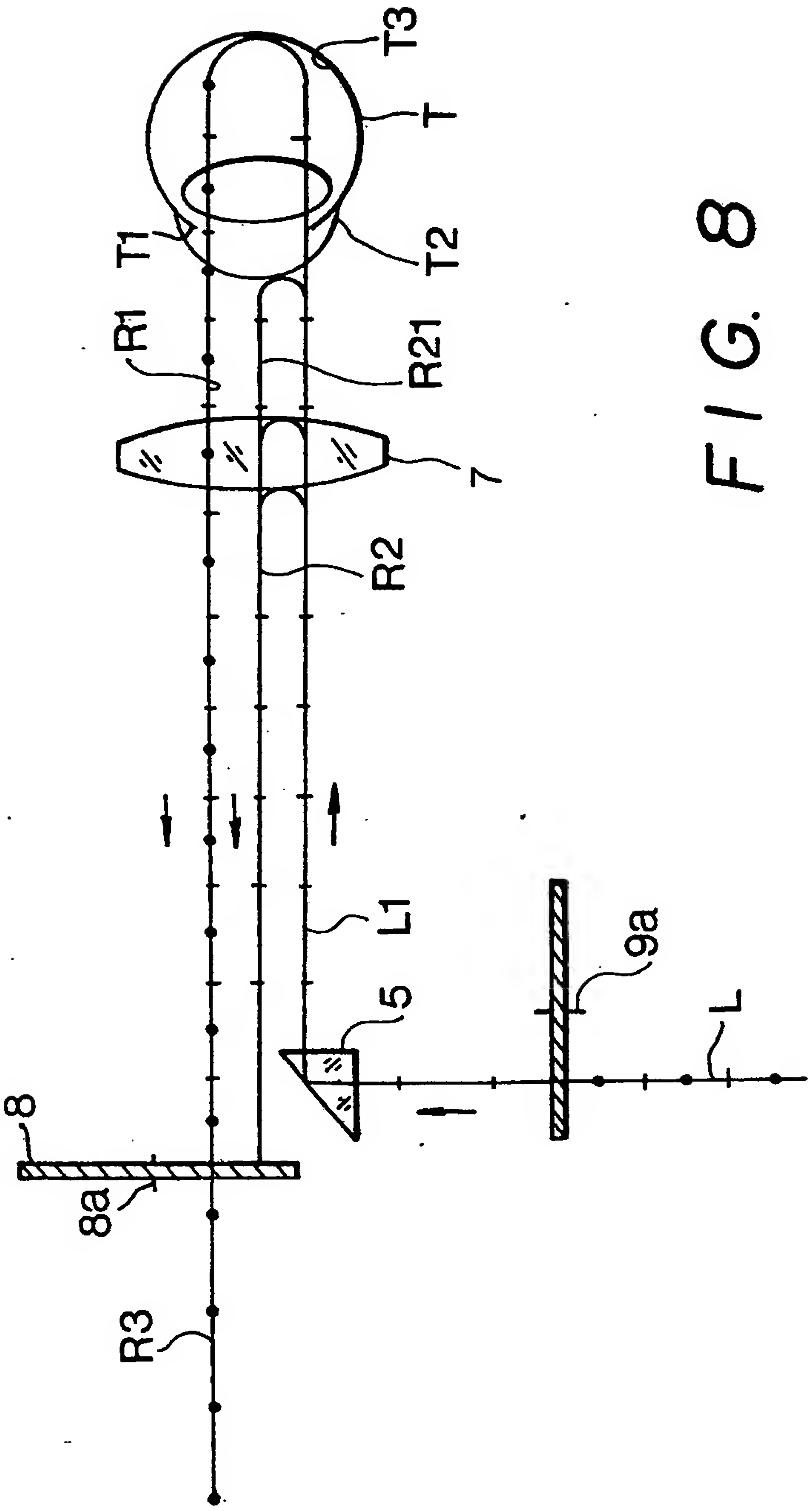

FIG. 8

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OPHTHALMOSCOPE FREE FROM CORNEAL REFLECTION

The present invention relates to an ophthalmoscope in which it is made difficult for the light reflected from the cornea of an eye being examined and the light of secondary reflection to enter the eyes of an examiner during observation of the eyeground.

Ophthalmoscopes are generally used to observe the image of an eyeground illuminated by incident light from the front of the cornea at a position forward of the eye to be examined by virtue of the incidence of illuminating light from the pupil of the eye to be observed. Many ophthalmoscopes have an optical structure such as those shown in Figs. 1 and 2 of the accompanying drawings.

The ophthalmoscope shown in Fig. 1 has a form in which the image of the eyeground is observed from in front of the pupil of an eye to be examined and at the centre thereof by virtue of the incidence of illuminating light in the eye from the pupil.

The incidence of illuminating light in an eye may include incidence at the centre of the pupil or incidence at a position slightly deviated from the centre of the pupil, but in both cases the same structure of ophthalmoscope is

employed.

In Fig. 1, reference number 1 denotes a light source; reference numbers 2 and 3, lenses; reference number 4, a diaphragm; reference number 5, a reflecting mirror; reference number 6, the lens of a diopter adjusting lens board; T, an eye to be examined; T_1, the pupil thereof; T_2, the cornea; T_3, the eyeground; D, the eye of an examiner; L, illuminating light; and R, reflected light.

The ophthalmoscope shown in Fig. 2 has a form in which the inverted image of the eyeground T_3 is observed and an optical structure in which the eyeground T_3 can be observed at a wide angle by placing a convex lens 7 for convergence and magnification at a position in front of and close to the eye to be examined as in the optical system of the ophthalmoscope shown in Fig. 1.

However, the above-described conventional ophthalmoscopes display a disadvantage in that the illuminating light L reflects on the surface of the cornea T_2 of the subject eye T and the reflected light R enters the eye D of the examiner and thus inhibits observation of the eyeground T_3.

With respect to this point, an ophthalmoscope has been known in which the illuminating light L is made incident upon the eye at a position slightly deviated from the center of the pupil T_1 in order to eliminate the ingress of the

reflected light R from the cornea T_2 in the field of view of the observer's eyes, but this has another disadvantage in that pupil has to have a large aperture.

In addition, since it has been most effective for a light source which is minimally small and has high luminance to be used as the light source 1, this light source is imaged on the pupil T_1 of the subject eye T so that the light enters the eyeground T_3 at a position slightly deviated from the center thereof, the size and brightness of the light source 1 have been limited.

On the other hand, the ophthalmoscope shown in Fig. 2 has an advantage in that it is possible to observe from a position relatively far apart from the subject eye T (actually about 50 cm) because the eyeground T_3 can be observed at a wide angle after magnification by the convex lens 7, but also has a disadvantage in that the illuminating light L reflects on the surface of the convex lens 7 and it is therefore easy for this observation to be adversely affected by this reflected light combined with reflections on the surface of the cornea T_2. Some ophthalmoscopes having the structure shown in Fig. 2 have a form in which an examiner can observe the eyeground of a subject binocularly.

In consideration of the above-described disadvantages

of conventional ophthalmoscopes, the present invention has been achieved with a view to providing an ophthalmoscope which prevents illuminating light from entering the eyes of an examiner or makes it difficult to enter if reflected from the cornea. The invention mainly comprises a light source, a condenser lens, a diaphragm, and a mirror and is provided with an illumination optical system for irradiating the eyeground of a subject with the light from the light source and an observation optical system comprising lenses for observing the eyeground of the subject which are placed in the reflecting light path of the illumination optical system, and is characterized by having an analyzer inserted on the observation optical axis so as to enable a change in the angle of the polarizing axis.

Embodiments of the present invention will now be described with reference to the accompanying drawings in which:-

Figs. 1 and 2 referred to above are optical block diagrams of conventional ophthalmoscopes;

Fig. 3 is an optical block diagram of an embodiment of the ophthalmoscope of the present invention;

Fig. 4 is a drawing of the optical path showing the state of light in the embodiment in Fig. 3;

Fig. 5 is an optical block diagram of another embodiment of the ophthalmoscope of the present invention;

Fig. 6 is a drawing of the optical path showing the state of light in the embodiment in Fig. 5;

Fig. 7 is an optical block diagram of a further embodiment of the ophthalmoscope of the present invention; and

Fig. 8 is a drawing of the optical path showing the state of light in the embodiment in Fig. 7.

Referring to the drawings, Figs. 3 and 4 show the optical path of an embodiment of the ophthalmoscope of the present invention employing the form of ophthalmoscope shown in Fig. 1 and the same reference numbers as those of Fig. 1 denote the same members.

Therefore, Fig. 3 shows an ophthalmoscope in which a polar screen having a disc form as an analyzer 8 is rotatably provided behind a diopter adjusting lens board 6 through a mounting shaft 8a on the reflected light path.

In this way, the rays of reflected light R_1, R_2 are polarized by the analyzer 8 so that only the reflected light R_3 vibrating in one direction reaches the eye D of an examiner and thus only part of the reflected light R_1, R_2 which easily inhibits observation enters the eye D of the examiner.

In addition, since the angle of the polarizing axis can be changed at will by rotating the analyzer 8 around the shaft 8a thereof, any component desired to be cut off in the reflected light R_1, R_2 which inhibits observation can be selected by adjusting this angle.

Figs. 5 and 6 show an ophthalmoscope which comprises a polarizer 9 for plane polarization of illuminating light which is provided behind the lens 3 on the illuminating light path and an analyzer 8 which has its plane of polarization at right angles with the polarizer 9 and is provided in front of the lens 6 of the diopter adjusting lens board on the reflected light path. The relationship between the light from the light source 1 for illumination and the light incident on the eye D of the examiner in this ophthalmoscope is explained with the aid of Fig. 6.

Since the light L from the light source 1 is not polarized at all, the vibration of the light takes place in any direction at right angles to the direction of advancing light. This light L is polarized by the polarizer 9 and the optical path of the light L_1 alone which is vibrating in one direction is changed by the reflection mirror 5 and is made incident upon the eye T of the subject through the pupil T_1 thereof. At the same time, part of the above-described light L_1 which is a one-directional component is reflected on the surface of the cornea T_2

without losing its polarized property and becomes the reflected light R_2. On the other hand, the light reaching the eyeground T_3 is scattered on the surface of the eyeground T_3 and becomes the light R_1 in a non-polarized state. The above-described two kinds of reflected light R_1, R_2 therefore advance on the reflected light path toward the examiner. However, where the analyzer 8 is provided on the reflected light path so that the plane of polarization is at right angles with the polarizer 9, all of the light R_2 reflected on the cornea T_2 among the two kinds of light R_1, R_2 is cut off by the analyzer 8 and a one-directional component of the light R_1 reflected from the eyeground T_3 is cut off so that only the remaining components of the light R_3 reflected from the eyeground T_3 reach the eye D of the examiner.

Therefore, in the ophthalmoscope of the present invention shown in Figs. 5 and 6, the light R_2 reflected on the surface of the cornea T_2 which has conventionally inhibited observation of the eyeground is not incident upon the eye of the examiner.

In this embodiment, although the light R_1 reflected from the eyeground T_3 is polarized and absorbed by the analyzer 8 and thus the quantity of light is reduced, the reflection from the cornea of the eye T of a subject need not be considered in the manner described above, and thus

the entire surface of the pupil can be effectively used as a plane of incidence. Thus, the ophthalmoscope of the present invention makes it possible for illuminating light to be supplied which is brighter than that with a conventional one, this being achieved by increasing the size of the light source in order to compensate for the reduction in the quantity of light caused by polarization.

In addition, the light R in a crossed nicols state can be changed at will since the angles of the polarizing axes of analyzer 8 and the polarizer 9 can be respectively varied. In this case, the angles of the polarizing axes are changed by rotating the analyzer 8 and the polarizer 9 around the mounting shafts 8a, 9a, respectively.

Fig. 7 shows an optical block diagram of a further embodiment of the ophthalmoscope of the present invention having the form shown in Fig. 2. This ophthalmoscope comprises the polarizer 9 for plane polarization of the illuminating light L which is provided behind an object lens 3 on the illuminating light path and the analyzer 8 which is capable of allowing the reflected light R to assume a crossed nicols state and is provided near the eye D of an examiner on the reflected light path.

The relationship between the illuminating light L and the reflected light R in the optical system shown in Fig. 7 will be explained with the aid of Fig. 8.

The illuminating light L is changed into the light L_1 with a one-directional component by the polarizer 9 and advances on the illuminating light path. This light L_1 is reflected on the surfaces of a lens 7 and of the cornea T_2 of the eye T of a subject, becomes the reflected light R_2, R_{21}, and advances toward the eye of an examiner on the reflected light path together with the reflected light R_1 in a substantially non-polarized state having been scattered and reflected on the eyeground T_3. However, among the components of reflected light R_1, R_2, R_{21}, only the light R_3 which is a component at right angles with the light polarized by the analyzer 8 is incident upon the eye D of the examiner. As a result, it becomes possible to observe the eyeground T_3 while entirely or substantially entirely preventing the reflected light from reaching the eye of an examiner, this light having conventionally inhibited observation of the eyeground .

As described above, the ophthalmoscope of the present invention can produce a specific functional result in that the image of the eyeground entering the eye of an examiner can be observed without interference by the unwanted reflected light because all or almost all the reflected light reflected on the surfaces of the cornea and of the optical system is cut off by passing through the analyzer which is provided on the reflected light path so that the

polarizing axis can be rotated through any angle or by polarizing the illuminating light in one direction and then passing the reflected light which is produced from the reflection of the polarized light on the surfaces of the optical lens and of the cornea.

Thus, the ophthalmoscope of the present invention suffers no problem of the sort experienced by conventional ophthalmoscopes in which ophthalmoscopy must be conducted while finely adjusting the illuminating light with respect to the incident position and the incident angle relative to the pupil and it is hence very useful as an ophthalmoscope.

CLAIMS

1. An ophthalmoscope in which little reflection from a cornea is produced, which comprises a light source, a condenser lens, a diaphragm, a mirror and which is provided with an illumination optical system for irradiating the eyeground of a subject by means of the light from said light source and an observation optical system comprising lenses for observing said eyeground of said subject which is provided on the reflected light path of said illumination optical system, characterized by the insertion of an analyzer in which the angle of the polarizing axis is capable of being changed on the optical axis of observation on said reflected light path in said illumination optical system.

2. An ophthalmoscope free from reflection from a cornea which comprises a light source, a condenser lens, a diaphragm, a mirror and which is provided with an illumination optical system for irradiating the eyeground of a subject by means of the light from said light source, an observation optical system comprising lenses for observing said eyeground of said subject which is provided on the reflected light path of said illumination optical system and an analyzer, in which the angle of the polarizing axis is capable of being changed, provided on the optical axis of observation on said reflected light path in said

illumination optical system, characterized in that a polarizer is provided in which the angle of the polarizing axis is capable of being changed on the illumination optical axis of said illumination optical system so that the state of a substantially crossed nicols is formed by changing said angles of said polarizing axes of said analyzer and said polarizer.

3. An ophthalmoscope free from reflection from a cornea according to Claim 1 or 2, wherein said angles of said polarizing axes are capable of being changed by rotating said analyzer and said polarizer around the mounting shafts thereof.

4. An ophthalmoscope substantially as hereinbefore described with reference to Figs. 3 to 8 of the accompanying drawings.

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